

PORTABLE COMPUTER DISPLAY STRUCTURES

[0001] This application is a continuation of U.S. patent application Ser. No. 15/782,458, filed Oct. 12, 2017, which is a continuation of U.S. patent application Ser. No. 14/520,079, filed Oct. 21, 2014, which is a continuation of U.S. patent application Ser. No. 13/786,344, filed Mar. 5, 2013, now U.S. Pat. No. 8,866,989, which is a continuation of U.S. patent application Ser. No. 13/249,174, filed Sep. 29, 2011, now U.S. Pat. No. 8,395,722, which is a continuation of U.S. patent application Ser. No. 12/483,206, filed Jun. 11, 2009, now U.S. Pat. No. 8,456,586, each of which is hereby incorporated by reference herein in its entirety.

BACKGROUND

[0002] This invention relates to electronic devices and, more particularly, to display structures for electronic devices such as portable computers.

[0003] Portable computers typically have upper and lower housing portions that are connected by a hinge. The lower housing portion contains components such as printed circuit boards, disk drives, a keyboard, and a battery. The upper housing portion contains a display. When the computer is in an open configuration, the upper housing portion is vertical and the display is visible to the user of the portable computer. When the computer is closed, the upper housing lies flat against the lower housing. This protects the display and keyboard and allows the portable computer to be transported.

[0004] Portable computer displays typically contain fragile structures such as layers of glass and can be challenging to mount properly within the upper housing. If care is not taken, the display and the surrounding portions of the upper housing will be bulky and unsightly. At the same time, the elimination of certain structures in the display may result in display that is overly fragile. This could lead to damage to the display during normal use.

[0005] It would therefore be desirable to be able to provide improved display structures in electronic devices such as portable computers.

SUMMARY

[0006] An electronic device such as a portable computer may have a housing. The housing may have upper and lower portions that are connected by a hinge. A display module may be mounted in a portion of the housing such as the upper housing portion.

[0007] The upper housing may have a planar rear surface and portions that extend upwards to form peripheral housing sidewalls. The housing sidewalls may extend around the display module to form a border or the display module may be mounted so that the outermost edges of the display module are aligned with the outermost edges of the peripheral housing sidewalls.

[0008] The display module may have a color filter glass layer and a thin-film transistor substrate layer. A layer of light-guide structures may be mounted under the thin-film transistor substrate layer. The peripheral edges of the color glass layer and the thin-film transistor substrate layer may extend laterally past the peripheral edges of the light guide structures to form an overhanging structure. The overhanging structure may rest on the peripheral housing edges without any intervening display module chassis members.

[0009] An opening may be provided through the color filter and thin-film transistor substrate layers. A camera may receive light through the opening. Other electronic components may also be mounted within the housing of the electronic device such as ambient light sensors, proximity sensors, other sensors, indicator lights such as light-emitting diodes, input-output ports, buttons, microphones and speakers, antennas, etc. These electrical components can be electrically connected to traces formed on the underside of the thin-film transistor substrate layer or traces formed on other glass surfaces.

[0010] To block unsightly portions of the device from view around the periphery of the display module, the display module may be provided with an opaque border. The opaque border may be formed from a peripheral ring of black ink. The black ink may be formed on a glass layer such as the color filter glass. A polymer film that includes a black ink may also be used in forming the opaque border.

[0011] If desired, the display module may contain no cover glass layers. In this type of configuration, the outermost glass layer in the display module may be formed from the color filter glass. The polymer film layer and other layers such as polarizing layers may be formed on top of the color filter glass layer.

[0012] The display module may contain integrated circuits such as display driver circuits. A display driver circuit may be mounted on the thin-film transistor substrate. A support structure such as a glass member with a recess to accommodate the drive circuit may be placed over the driver circuit. The support structure may support coating layers such as the polymer film layer with the opaque border.

[0013] Further features of the invention, its nature and various advantages will be more apparent from the accompanying drawings and the following detailed description of the preferred embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIG. 1 is a perspective view of an illustrative portable computer with display structures in accordance with an embodiment of the present invention.

[0015] FIG. 2 is a cross-sectional side view of a conventional liquid crystal display (LCD) module in a portable computer display housing.

[0016] FIG. 3 is a cross-sectional side view of an edge portion of a conventional LCD module.

[0017] FIG. 4 is a cross-sectional side view of an illustrative display module in an electronic device such as a portable computer in accordance with an embodiment of the present invention.

[0018] FIG. 5 is a cross-sectional side view of an illustrative display module with a thin plastic coating that has a border region that is coated with an opaque ink in accordance with an embodiment of the present invention.

[0019] FIG. 6 is a cross-sectional side view of a portion of an illustrative display module for an electronic device such as a portable computer in accordance with an embodiment of the present invention.

[0020] FIG. 7 is a cross-sectional side view of a portion of an illustrative display module that has extending portions that rest on housing walls in an electronic device such as a portable computer in accordance with an embodiment of the present invention.

[0021] FIG. 8 is a cross-sectional view of an illustrative electronic device showing how components such as a cam-